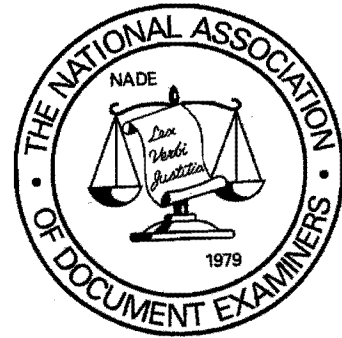


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JOURNAL OF THE NATIONAL ASSOCIATION OF DOCUMENT EXAMINERS

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EDITORIAL

The core articles in this issue began as conference presentations at the 2000 conference in Albuquerque, New Mexico, or as introductory material for the 2001 conference in London. As we know from our work with jurors, people learn in different ways. Seeing a presentation at the conference and then reading a related article is a great way to solidify new knowledge. Because NADE is beginning a new policy of Spring conferences, you can expect the next issue of your Journal to include many articles based upon 2001 conference presentations. With all this conference related activity, I took a moment to look up the word "conference" and its root word "confer" in the dictionary. What I found was interesting.

According to Webster's New World Dictionary, the root word "confer" means to compare opinions, to meet for discussion, or to give, grant or bestow a gift, honor or title. Surely this is a definition created for NADE conference attendees. Each year we take to the conference our most challenging cases to compare opinions with other examiners. We spend almost every waking moment discussing new and interesting developments in our field. We share our knowledge, and by doing so improve our own understanding of what we know. Most of all, by being present and presenting at conferences we bestow upon each other the gift of our time and effort.

In this issue Jacqueline Joseph explains the process by which she researched and wrote an

annotated Bibliography. Her article defines the process and is itself a bibliography of sources to assist the writer of bibliographies. Katherine Koppenhaver's article puts children's writing in perspective as the first step on the Road to Graphic Maturity. My own conference presentation on Biomechanics and Significance is presented in article form.

We were fortunate to have Dr. Michael Claybourn and Mr. Michael Ansell of the UK speaking at the 2001 conference and giving a demonstration of Raman Spectroscopy. Dr. Claybourn has written an Introduction to Raman Spectroscopy which was excellent background for those attending the conference and informational as well for those who were not able to attend.

In addition, we present some research on development of indented writing by J. Wright Leonard; and two Case Notes, one involves a questioned faxed document by Linda James, and the other covers the use of a Video Spectral Comparator by Kay Micklitz.

These articles, like conference presentations, are gifts from the authors to the readers, who return the gift by reading, learning and perhaps by writing articles and making conference presentations in return. In this way we all improve our skills as individual document examiners and contribute to the growth of the profession.

Emily Will, M.A., CDE

HANDWRITING, BIOMECHANICS AND SIGNIFICANCE: CONCEPTS IN HANDWRITING IDENTIFICATION

by

Emily J. Will, M.A., CDE

In his classic work, *Experiments With Handwriting*,¹ published in 1978, Robert Saudek described the work of Mr. Frank Freeman in videotaping and measuring the movement of the pen, hand, wrist and arm during the writing process, and in calibrating these measurements with the artifact of the handwriting line on the paper. A full explanation of this work appears in Mr. Freeman's *The Handwriting Movement - A Study of The Motor Factors of Excellence in Penmanship*,² written circa 1920.

Frank N. Freeman was an Associate Professor of Educational Psychology at the University of Chicago in 1915 when he began his study into the factors that resulted in excellence in handwriting. With the cooperation of a few primary school teachers and funding by the General Education Board, he took what were then called motion pictures of the act of handwriting and studied them intensively. Quoting from Mr. Freeman's introduction (pgs. 1-2):

The study which is the subject of this report had two aims, a theoretical one and a practical one. The theoretical aim was to analyze the writing activity of good and poor writers and to discover the difference between them. The practical aim was to find and test means of training the poor writer so that his mode of writing would

resemble that of the good writer. The theoretical aim was subordinate to this practical aim.

Three phases of the writing activity were examined in the present study. The first was the position of the hand and arm, including the grasp of the penholder. Five aspects of hand position were studied.

The second phase that was studied was the writing movement in its gross aspect, which is usually designated by the terms 'finger movement,' 'hand movement,' and 'arm movement.'

The third phase is perhaps the most important. It concerns the manner in which the pen movement varies in rapidity from one part of a letter or word to another. The speed of pen movement is never uniform. It fluctuates between slow and rapid flights, broken at intervals by actual pauses. The flights of the pen, which are separated from one another by pauses or by marked retardation in speed, may be described as units of movement. Good and poor writers differ in the manner in which they divide the whole movement into units.

This examiner asserts that genuine and non-genuine writings are also differentiated in the manner in which the whole movement is divided into units. There is ample support for this comment from authorities in our field. For example, in *Questioned Documents – Second Edition*,³ pg. 98, Albert Osborn says,

This subject of rhythm, or the balanced quality of movement, producing a natural and not a constrained or artificial result, has a very close connection with the identification of handwriting as genuine or forged or as having been produced by a certain writer.

On page 106 Osborn says,

Forged writing is usually produced by a disconnected and broken movement, and to produce practically the same form requires many more interrupted motions or movement impulses than genuine writing.

In the chapter on Methods and Apparatus, Mr. Freeman explains what he plans to do in his study:

Records can be made from the photographs (motion pictures) by projecting them upon the screen and drawing the outline of the hand from

the projected image.⁴

Figure 1, below, shows the setup for this work.

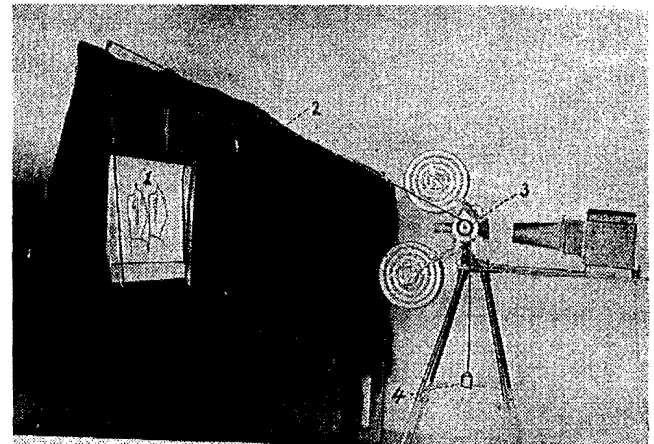


Figure 1 - *The Handwriting Movement*
- Frank N. Freeman - Pg. 25

Continuing to quote Mr. Freeman,

By comparing the drawings of the hand which are made at set places in the writing, the hand movements which take place between the positions represented can be indicated.⁵

The speed of movement of the pen can be measured by recording the distance which the pen point travels during each exposure of the camera or from one exposure to the next, and a speed curve can be

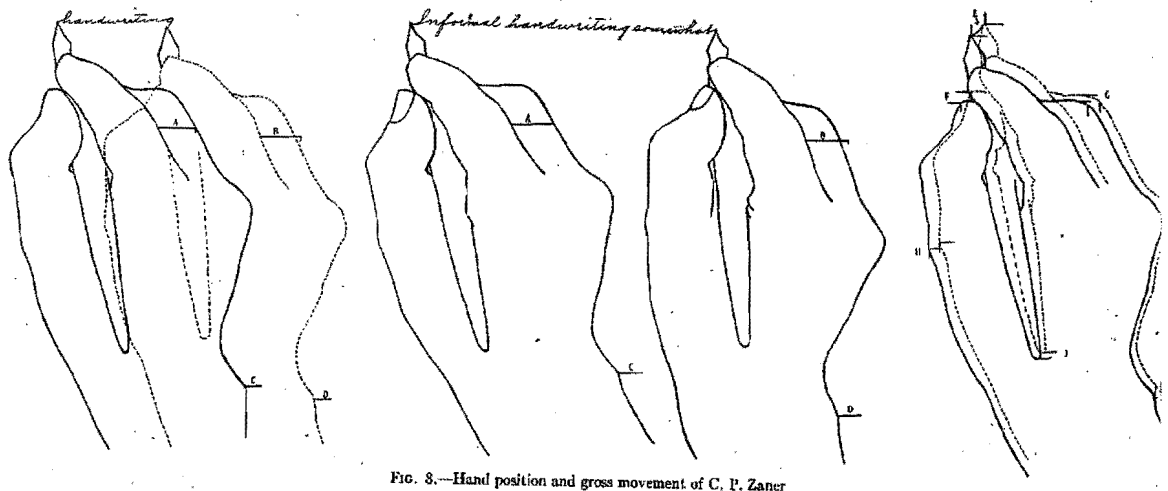


FIG. 8.—Hand position and gross movement of C. P. Zaner

Figure 2 - *The Handwriting Movement* - Frank N. Freeman - pg. 34

constructed by plotting these successive distances on a chart.⁶

Most photographs have been taken at 25 exposures per second since this proved to be sufficiently rapid in most cases. The rate at which motion pictures are usually taken is 16 per second. The more rapid rate was necessary in order to get a record of the details of the movement.⁷

Saudek refers to 1/25th of a second as a Freeman Unit.⁸ Let's take a quick look at some illustrations of Mr. Freeman's analysis of the motion pictures, which are extraordinarily thorough, methodical and interesting.

The clearest and most convenient way to represent the speed changes in writing is to indicate them directly on the writing itself. This may be done by indicating the position of the pen point at each successive unit of time. The unit of time which is represented is the interval between one exposure of film and the next, which in most cases is about 1 25th of a second.

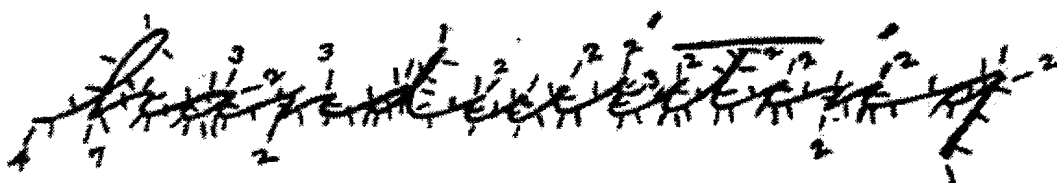
The interval in any particular record is constant, which is sufficient for the analysis about to be made. The speed of the movement then, corresponds to the distance between the short cross-lines.⁹

So if we look at this word "handwriting" in Figure 3, we can readily see that the tic marks placed farthest apart indicate the greatest speed of the writing, because more distance was covered during a Freeman unit. The numbers indicate that there was a pause for that number of frames (or that many 25ths of a second).

Mr. Freeman goes on to make a different kind of chart based upon this information for the purpose of studying the rhythm or lack thereof in the speed of the writing. The word "handwriting" has been broken down into actual strokes (amount of writing between measurable pauses) and above each stroke a

graph of the pen's activity has been constructed, as in Figure 4 below. Again, in Mr. Freeman's words:

Each horizontal unit represents one exposure of the camera, or 1/25 of a second. The height of the column above each unit represents the distance in millimeters which the pen traveled during corresponding camera exposures. Absence of a column indicates a pause of 1/25 of a second.¹⁰



-The writing of C. P. Zaner and the analysis of the speed on one word

Figure 3 - *The Handwriting Movement* - Frank N. Freeman - pg. 32

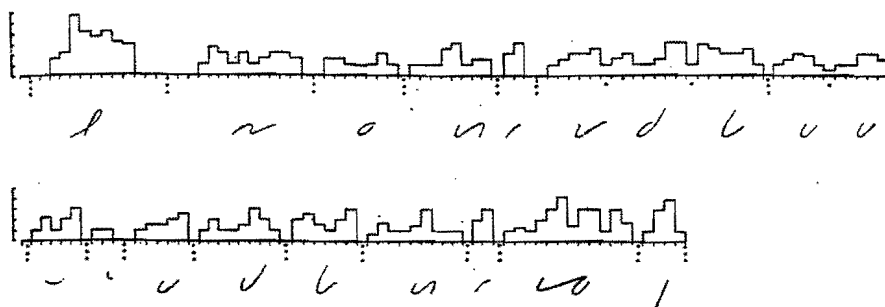


FIG. 7.—Speed curve from the word "handwriting" written by C. P. Zaner

Figure 4 - *The Handwriting Movement* - Frank N. Freeman - pg. 33

To explain further, the first stroke creates the loop of the "h." In Figure 3 you can count eight marked divisions of unequal length along the written line from the beginning to the end of this first stroke. The third division contains the greatest space between markers in Figure during that part of the stroke because more distance was covered during 1/25th of a second. Refer to the close-up view in Figure 5 at the end of this article for clarification. The red and green color mark the pen travel during the third and fourth Freeman Units respectively. The numbers 4 and 7 on the left refer to the number of Freeman units that the pen paused at those locations.

Mr. Freeman goes on to interpret the speed curves of several writers relating the information to the changes in hand positions shown in the moving pictures. One conclusion that is of interest to us is that "good writers organize the movement much more clearly into speed units than do poor writers, and these units are better adapted to the form of the letters which are being written."¹¹

Contemporary work with the biomechanical aspects of handwriting is being done aggressively by the members of the International Graphonomics Society (IGS)¹² which is headquartered at Nijmegen University in The Netherlands. The IGS is a society dedicated to the study of the science and technology of handwriting and other graphic skills. Granted, much of their interest is directed toward computer recognition of handwriting, and the reader might think, "What does that have to do with Document

Examination?" Some possible relationships are:

1. Scientific measurement and efforts to understand any aspect of handwriting are useful to the document examiner who faces criticism of the process of handwriting identification as being non-scientific. As Beryl Gilbertson wrote in her article *On Being Scientific in Handwriting Identification*, "handwriting identification may not in the end, be judged as a science, but it is based upon scientific principles."¹³
2. If a computer can recognize individual handwriting, as some security systems are now doing, then this is additional proof of what document examiners assert - that handwriting is an individualized activity that can be linked to one person.
3. The IGS itself sees a relationship between its work and forensic science. It lists forensic science as one of its areas of focus for its 2001 biennial convention - and defines forensic science to include document examination, case studies and new scientific techniques, and writer identification procedures.¹⁴

Articles written by members of the IGS use a vocabulary that is not necessarily familiar to the document examiner. For many IGS members the prime area of interest is motor control, and it turns out that by studying handwriting and other graphic tasks, a lot can be learned about motor control. Therefore, much research has been done with handwriting as the focus. Specialists in motor control are the prime audience for the papers

resulting from this research, but there is much of interest to handwriting experts if they are willing to learn some new vocabulary. For example, in an article in the October 1999 issue of the IGS Bulletin, Arend Van Gemmert of the Motor Control Laboratory at Arizona State University writes in an article entitled *The Study of Kinematics of Graphic Tasks: A Forensic Perspective*.¹⁵

According to the isochrony principle, the duration of a stroke tends to be independent of its size (Thomassen & Teulings, 1985)

In other words, a longer stroke does not necessarily take a longer time to write. He goes on to quote:

The tangential velocity of the pen along a curved trajectory is directly proportional to the local radius of the curve, which is known as the 2/3 power law. (Lacquaniti, Terzuolo & Viviani, 1983) Therefore, local pen speed is much higher in parts of the trajectory with only shallow curves than in parts with tight curves.¹⁶

This examiner has constructed a drawing to illustrate an interpretation of this law. See Fig. 6 at the end of this article. In segment 1 of the drawing you see the letter "d." In segment 2 the same "d" is shown in four colors. Each

color represents one of four arcs that form the letter. In segments 3,4,5 and 6 each arc is highlighted individually in the order it would be written, as part of a complete circle with its center and radius included. This helps you to see which circle has the largest radius and contains the most shallow arc, and which circle has the smallest radius and contains the tightest, or deepest arc. The 2/3 power law tells us that the pen was moving fastest during the pink arc in segment 6. The next fastest speed was in the turquoise arc in segment 4, then the red arc in segment 3, and finally the slowest pen speed occurred during the green arc in segment 5.

Beryl Gilbertson discusses the application of the term "scientific" to the field of "handwriting identification," and refers to the "middle way."¹⁷ The 2/3 Power Law is an example of a scientific principle derived in another field of study that may be useful to the document examiner once s/he has made the effort to find and understand that information.

As a final thread, consider some comments upon the use of terminology in reports and testimony. The expression of a document examination opinion often relies heavily upon the words "similarity", "similar", "differences", "different". This examiner opposes the use of these words, thinking that they bring us nothing but trouble. They are non-specific words that mean one thing to one person, and something else to another. One person's "similarity" is someone else's "difference". How close do traits need to be to be "similar" and how dissimilar to be "different"?

When first deciding to eliminating the terms "similar" and "different" from the document examination vocabulary, one may be struck silent for some time while deciding on replacements. Perhaps the word "similar" has to go entirely, but "different" could be used with the proper modifiers attached. Here are some alternatives:

1. "The known and questioned signatures have the following characteristics in common:"
2. "Both the known and questioned signatures possess the following (individualizing) characteristics:"
3. "The following significant, individualizing characteristics appear in both the known and questioned signatures:"
4. "The following significant, unexplained, structural differences appear and serve to differentiate the questioned writing from the known writing."

This is where we come full circle. The term "structural difference" means to this examiner that a difference appearing in the structure of the writing is the result of a second mental and/or physical system at work. Now a knowledge of biomechanics can help us because mechanics deals with structure and formation - with angles, velocity, pressure.

We are no longer talking about how the writing "looks" which is very subjective and open to interpretation. We are talking about how the writing was constructed, which can be discussed objectively - even scientifically. This change of vocabulary is not a magic potion that will rock opposing attorneys to

sleep. There is still the need to explain what are these structural differences and why they are individualizing characteristics. But the discussion can now be elevated.

In his concluding remarks, under the heading of Practical Recommendations, Frank Freeman says:

We are primarily concerned in this study of the efficiency of handwriting, with handwriting as a movement. This preoccupation with the movement phase assumes that the difficulty which confronts the child in learning to write well is concerned more with the movement than with the perception of letters.¹⁸

Isn't this the same problem that confronts the forger and the document examiner - to get beyond the perception of the form of the letter and to get to the movement that actually creates the letters? The word "similar," no matter how it is used by the document examiner, in the minds of the attorney, judge and jury means "looks like," and that is not where we want to focus their attention. We can, instead, draw upon past and present scientific experiments and principles to correctly evaluate the structural differences that appear when two biomechanical systems (two people) produce handwriting.

Additional Illustrations Follow

References:

1. Saudek, Robert, *Experiments in Handwriting*, Second edition, Books for Professionals, Sacramento, California, 1978, pgs. 71-75
2. Freeman, Frank N., *The Handwriting Movement - A Study of the Motor Factors of Excellence in Penmanship*, University of Chicago Press, Chicago, IL, circa. 1920
3. Osborn, Albert S., *Questioned Documents*, Second Edition, Patterson Smith, Montclair, NJ, 1978
4. Freeman, Frank N., *The Handwriting Movement - A Study of the Motor Factors of Excellence in Penmanship*, University of Chicago Press, Chicago, IL, circa. 1920, pg. 15

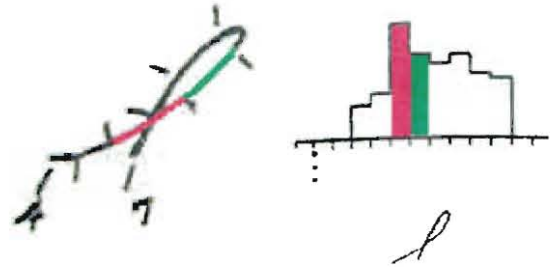
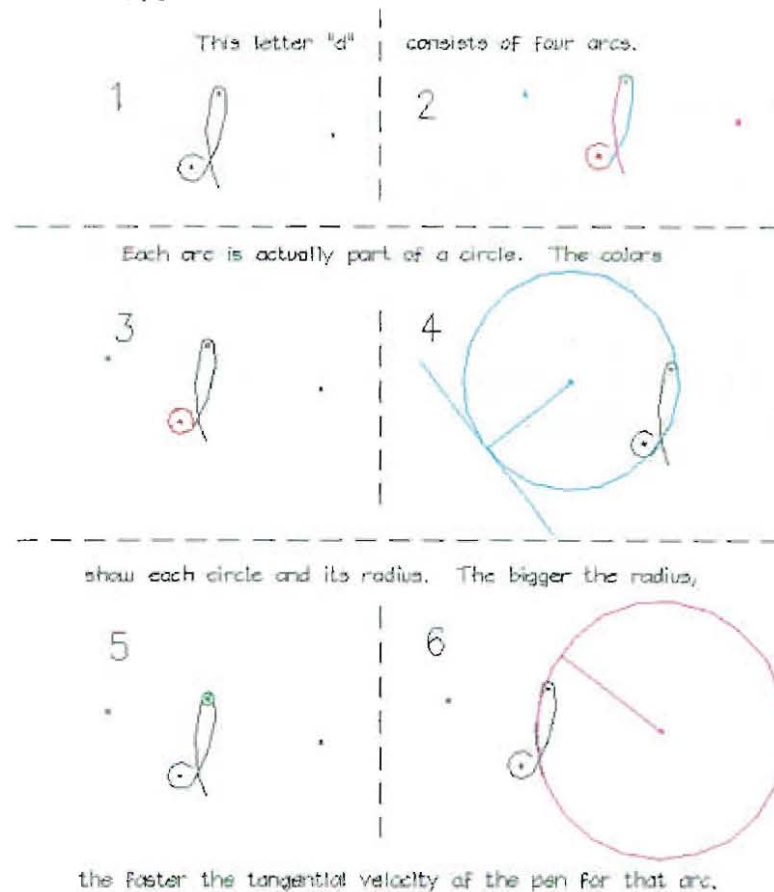


Figure 5

Figure 6



5. Ibid
 6. Ibid
 7. Ibid, pg. 20
 8. Saudek, Robert, *Experiments in Handwriting*, Second edition, Books for Professionals, Sacramento, California, 1978, pg. 72
 9. Freeman, Frank N., *The Handwriting Movement - A Study of the Motor Factors of Excellence in Penmanship*, University of Chicago Press, Chicago, IL, circa. 1920, pg. 38
 10. Ibid, pgs. 39-40
 11. Ibid, pg. 52
 12. International Graphonomics Society, Department of Experimental Psychology, University of Nijmegen, P.O. Box 9104, 6500 HE Nijmegen, The Netherlands
 13. Gilbertson, Beryl, *On Being Scientific in Handwriting Identification*, The Journal of The National Association of Document Examiners, Inc., Vol. 23, No. 2, Fall 2000, pgs. 13-17
 14. 10th Biennial Conference of the International Graphonomics Society, Call for Papers, Nijmegen Institute for Cognition and Information, The Netherlands
 15. Van Gemmert, Arend W.A., The Study of Kinematics of Graphic Tasks: A Forensic Perspective, *Bulletin of the International Graphonomics Society*, Vol.13, Issue 2, October 1999, pgs.35-38
 16. Ibid
 17. Gilbertson, Beryl, *On Being Scientific in Handwriting Identification*, The Journal of The National Association of Document Examiners, Inc., Vol. 23, No. 2, Fall 2000, pgs. 13-17
 18. Freeman, Frank N., *The Handwriting Movement - A Study of the Motor Factors of Excellence in Penmanship*, University of Chicago Press, Chicago, IL, circa. 1920, pg. 159
- Emily Will is a Certified Document Examiner and has a Master's Degree in Counseling from Syracuse University. She is the Chief Editor of the Journal of The National Association of Document Examiners, Inc.. Ms. Will has been a document examiner in North Carolina for 15 years, and has examined cases from 20 states, Canada, China and Saudi Arabia. Her Questioned Document website (Qdewill.com) has been online since 1995. She has had articles on document examination published in Trial Briefs, The NADE Journal, The International Journal of Forensic Document Examination, and Chemistry in Australia.*

**COMPILING AND PUBLISHING AN
ANNOTATED BIBLIOGRAPHY**
A Step-by-Step Guide for the Handwriting
& Document Examiner

by
Jacqueline A. Joseph, B.A., CDE

Aristotle said that a thinker should first become familiar with the work of predecessors. He said all credit due must be given to others and recognition made that one's advances were based on others' work. (1)

The compilation and subsequent publishing of an annotated bibliography can occur after researching a case. It is an acknowledgement of sources referred to or used with reference to the subject under investigation. It is a useful contribution to other professionals as a reference guide. As a published professional, your particular annotated bibliography can direct interested parties to you specifically, for knowledge of the subject. Attorneys can use this information for cross-examination, and for minimizing damage from incomplete and inaccurate opinion testimony.

An annotated bibliography is a list of all reference material and works consulted and reviewed during the preparation of the opinion and testimony. Even if nothing from a particular work was used, including it indicates your range of research. This also directs future systematic searches as part of related topics. Far from exhaustive, a selected bibliography will alert readers to your guidelines and scope for including or omitting certain subjects.

The annotations summarize the contents of a

published work. Annotations include whether or not the work contains illustrations, charts, detailed guidelines, a glossary, appendix and/or a bibliography. If the author's biographic footnote is included, it is contemporaneous to the date of publication. Not all entries necessarily need an annotation, and the absence of an annotation should not be taken as implying that the work has less value than annotated entries.

Elements of an annotated bibliography:

1. A carefully worded **Title** will direct readers to the specific concern and scope of your particular subject.
2. The **Compiler's Comments** section will give the background information and premise about your topic from which the focus of your research is based.
3. A **Disclaimer** will limit the reader's thinking and concerns derived from the reading of the works cited. For example, in the recently published *Annotated Bibliography of Genuine Tremor in Handwriting vs. The Tremor of Fraud*, this author alerted the reader that the information derived from the works cited would not equip one to give any kind of diagnosis. Also, the readers are cautioned against assuming that any single finding automatically becomes a "law" of handwriting identification.
4. The **Table of Contents** will list a number of items and the specific sections such as "Books," "Scientific/Legal/Forensic Journals," and "Case Law Citations." Entries are arranged alphabetically and page numbers are indicated.

5. Each **Citation** will give the book/journal name, issue number, page number, year of publication, title and author.

6. Each **Annotation** will be a summary of what the work discusses, and will emphasize why the work is valuable. It could also include a critique of the research, comments about the author, and as mentioned above, whether or not it contains illustrations, charts, glossary, index, and to what degree the particular work is extensive.

7. The **Case Law Citations**

8. The **Author Index**

9. The **Subject Index**

10. The **Journal Index**

The final format and style of the annotated bibliography should be in compliance with the style guides listed herein. For printing resources other than desktop publishing, one can refer to Kinko's or other local quick-print services. The annotated bibliography also can be published on one's web-site.

Given as handouts during various professional speaking engagements, the annotated bibliography serves as a valuable promotional tool for handwriting and document examiners.

The following references were taken from *Scientific Style and Format Guides: The CBE Manual for Authors, Editors and Publishers*, 6th ed. which is a reference provided by the Council of Biology Editors.

SCIENTIFIC STYLE AND FORMAT GUIDES:

1. *The Chicago Manual of Style*, 14th ed. Chicago: Univ Chicago Pr; 1993.

This manual sets standards for style and format in scholarly publishing with general information and many details of publication style. This work covers editorial procedure in book publishing and gives details of book design and productions. Extensive glossary; detailed index.

2. *The MLA Style Manual*. WS Achtert, J Gibaldi. New York: Modern Language Assoc of America; 1985.

Procedure writing and publishing, details of publication style, and citation and reference formats. This might be more useful for writers in the fields of literature and the humanities than in science.

3. *Webster's Standard American Style Manual*, Springfield (MA): Merriam-Webster; 1985.

Similar to The Chicago Manual of Style, but more on scientific style. Much of the manual relates to indexing, copy-editing, proof correction, and book production. Includes glossary, bibliography, and index.

4. *The Oxford Dictionary of Abbreviations*. Oxford Univ Pr. 1992.

A compact but comprehensive dictionary with emphasis on abbreviations of British origin but also includes abbreviations from the Commonwealth countries and the United States. Conventions such as italicization and boldfacing are included. A good source for the scientific abbreviations and those representing academic diplomas and degrees, honorific titles, and military ranks.

5. *Lauther's Complete Punctuation Thesaurus of the English Language*. H. Lauther. Boston: Branden; 1991.

A thorough guide to punctuation, structured by elements needing punctuation rather than by punctuation marks: words, phrases and adverbial clauses, sentences, quotations, time statements, questions, lists, numbers, titles, and names. Different sections cover marks, hyphenation, capitalization, and abbreviation.

6. *Copy-Editing: The Cambridge Handbook for Editors, Authors and Publishers*, 3rd ed. J. Butcher, Cambridge (UK): Cambridge Univ Pr; 1992.

A logical, clear and comprehensive guide to preparing a book for publication. This information would also help writers of manuscripts or articles for journal publication.

Appendices cover non-English alphabets and abbreviations, mathematical and phonetic symbols, electronic typescript information, and checklists for steps in copy-editing. There are also formats for bibliographic references and style.

7. *Bibliography of Publications Designed to Raise the Standard of Scientific Literature*. Paris: UNESCO; 1963.

Over 300 annotated references to books, standards, and pamphlets on language, composition, technical writing, editing, printing, publishing, information retrieval, indexing, and publication conventions and style. Subjects, authors, and languages of publication are all indexed.

8. *Graphic Design for the Electronic Age*. JV White. New York: Watson-Guptill Publications, Xerox Pr. 1988.

Nicely illustrated sections on design and layout that include extensive descriptions of the type characteristics, compilations of

commonly used symbols, and summaries of the uses of punctuation.

9. *Symbol Sourcebook: An Authoritative Guide to International Graphic Symbols*. H Dreyfuss. New York: Van Nostrand Reinhold; 1984.

Illustrations of non-scientific symbols as well as sections on graphic symbols in astronomy, biology, chemistry, geology, mathematics, medicine, meteorology, and physics. In one section symbols are grouped by graphic forms. The reader can learn a symbol's meaning from its characteristics of form (such as circle, triangle, and so on).

10. *Xerox Publishing Standards: A Manual of Style and Design*. New York: Watson-Guptill Publications; 1988.

A text on design, layout, and typography with a comprehensive section on the organization of books, technical reports, and other publications.

(1) Private library of Marcel B. Matley. San Francisco, CA 2000.

Jacqueline A. Joseph, B.A., CDE, is a certified document examiner. As a practicing forensic scientist since 1992, she is the owner of Accurate Document Examiners in Portland, Oregon. She compiled "Genuine Tremor in Handwriting vs. The Tremor of Fraud: An Annotated Bibliography" She has lectured at Portland State University and has given expert witness testimony in court, arbitrations and depositions. Ms. Joseph is the Certification Chairman of the National Association of Document Examiners.

THE ROAD TO GRAPHIC MATURITY

by

Katherine Koppenhaver, BCDE, Diplomate

While most document examiners work with questioned handwriting on a daily basis, the examination of handwriting of children is not commonly requested. For examiners who may not be as familiar with the writing of children as with the writing of adults, this article looks at the handwriting of children as the first step on the road to graphic maturity.

When do children begin to learn to write? What are the skills needed for anyone to learn to write? In *Experiments with Handwriting*, 1978, Robert Saudek¹ writes about the three things that must come together in order for a child to write:

1. The power of observation, which Saudek terms visual impressionability. This is the ability to see the individual letter forms.

2. The capacity for graphic expression, which is the conceptual ability to copy the letter forms correctly.

3. Technical execution, which is the ability to overcome the mechanical and physical constraints of holding the writing instrument in a suitable manner and propelling it across the paper. Technical execution was more difficult in Saudek's time than it is now.

Early paper finishes were not as suitable as modern paper finishes, and ink was absorbed by the paper. Early writing instruments did not flow across the paper as smoothly as do ball- point pens and other modern writing instruments.

The process of learning to write begins during the formative years when children begin to observe their surroundings. Young children see the shapes of letters that are on signs, television, children's books and toys. They play with building blocks and magnetic letters and enjoy other educational games and activities. Saudek tells us that "Our world is full of printed matter: the streets abound with letters of every color, and the golden and gaily colored forms of these letters impress themselves on the child's memory long before he has any idea that the shapes which glide past his eyes are letters and numbers." (Saudek p. 18)

With the stimulation of educational television, video games, songs and toys, many children learn the alphabet before entering kindergarten. Learning the alphabet is one of the first steps in learning to write. Another important early influence is reading to young children, which helps them to develop the concept that writing has a purpose

Children begin to develop manual dexterity long before they learn to write when, as babies, they reach for and grab an object. They continue to develop these skills by playing and repeating actions over and over. Young children of about two years old will pick up a pencil and scribble with it in imitation of their parents or older siblings. They will scribble on any surface: a wall, furniture, library books, their bodies and anything else that will accept pen or pencil.

Learning to color within the lines helps children learn to control finger and hand movements. Many children learn to print their

¹ Robert Saudek conducted these experiments in the 1950s, 1960s, and 1970s.

names in uppercase letters before they go to kindergarten. They may learn to print their siblings' names and "Mom" and "I love you." Most children will use block letters at first. Drawing is also a precursor to writing. Young children between three and five draw a person without distinguishing head from body and then move to making that distinction further down the road.

At school, children learn to print their names using lowercase letters. They are taught to print with big pencils and double-lined spacing. They are given a model of each letter and then an outline that they trace. They then form the letter by copying from the model. This training is fairly consistent regardless of the system of penmanship used. Currently in this country, Palmer, Zaner-Bloser and D'Nealian are the most common penmanship systems in use. A few other systems being taught are similar. Ball and stick letters seem to be the most prevalent print script in this examiner's local area.

Children are taught cursive writing, usually beginning in second or third grade. The D'Nealian system has gained popularity because the transition from printing individual letters to joining the letters is mainly in the addition of connecting strokes. As children learn cursive writing they begin using smaller pencils and are introduced to ball-point pens. They are still writing large, but beginning in about the fourth grade, children are likely to reduce the size of their writing.

Penmanship in the 20th century was taught as a subject throughout several more grades than

it is in modern classrooms. Many of us remember the exercises that accompanied penmanship class. Penmanship practice usually lasted ten to fifteen minutes a day during which the students were expected to work to achieve perfect penmanship.

Less emphasis is placed on penmanship in modern times. In fact, some schools do not teach penmanship but allow the students to use any method they want as long as the writing is legible. Emphasis used to be placed on proper posture and the proper method of holding the pen and placing the paper. Children used to be instructed to slant their letters to match a slant of 52 degrees. This is no longer the case. Today students hold pens in many different ways, some of which impede writing.

As they develop their skills in penmanship, children will adopt handwriting characteristics that they see and like. It is not unusual for children to copy from their parents or siblings. The resulting similarities are identified as familial characteristics.

When does individuality in handwriting begin?

There are people who mistakenly believe that young children's handwriting cannot be identified because it is imitative. However, each child's perception of letter forms and ability to duplicate the forms is different. Therefore, handwriting is distinctive from the time a child begins to write. Several authorities in the field recognize this individuality of handwriting. Wilson Harrison writes in *Suspect Documents*, "The departure

from the copybook standard of perfection begins at the very onset of the learning process." He goes on to add, "Even where letter formations are learned by the inking in of faint guide lines, there will be considerable variation in the way in which this extremely simple task is performed." (p. 292)

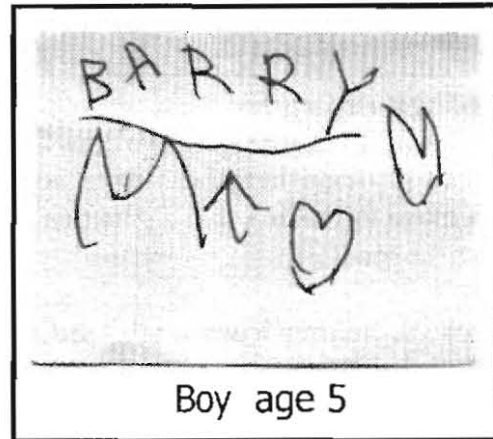
Consider some factors that make a person's handwriting individual: 1) observations of letter forms, 2) perception of individual letter forms, 3) various levels of writing skill based upon a person's manual dexterity, 4) method of holding the writing instrument, 5) the size of a person's hand and fingers, 6) the amount of practice the writer engages in, and 7) neatness versus speed. These factors are at work in the writing of children as well as in the writing of adults.

Characteristics of Young Children's Writing

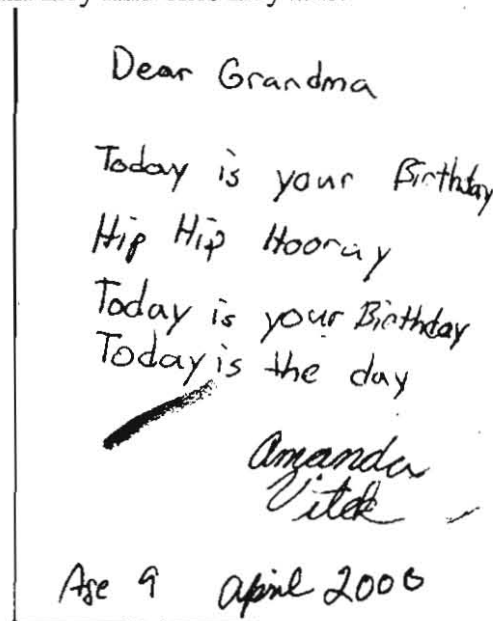
The document examiner can potentially identify handwriting as belonging to a young or immature writer by the following characteristics:

1. There are problems of uniform placement on the baseline.
2. Changes of direction are not smoothly executed.
3. The letters are drawn, not written.
4. Writing is slow and labored.
5. The writing is large. The child has difficulty writing small.
6. Letters vary in size in individual words.
7. Spacing is irregular with some words broken at unusual locations.
8. Letters are generally ball and stick letters, also called block printing. This is the

simplest form of printed letters.



During the early and middle teen years an experimental stage usually occurs in which children explore different styles of writing. They may modify letter forms, change their slant, size, proportions or any other characteristic of handwriting. They will stylize their signatures, trying different effects until they find ones they like.



November 1, 1984

Dear Mom,

Hi Mom! How did you like Washington. I sure liked it. I liked our group, but I hate the birds when they attacked us. It was funny when they threw their duffle bags at them. I loved the museums, they were great. I loved the dinosaur bones. I can't think of anything else to say because you saw it too, but I can say...

Love,
Anthony

Age 10

The transition to adult writing usually occurs between sixteen and eighteen. Saudek gives us the requirements for developing skill in handwriting as follows:

1. When the sound of the letter evokes its mental image.
2. When we have unimpeded control of the writing instruments.
3. When our performance is free from any physical impediment.
4. When we can spell the words easily.
5. When we are intent on the content of our writing and ignore the act of writing.

Saudek states that the conditions necessary to write automatically include the skills for developing handwriting as well as the lack of conscious awareness of the writing act and a complete familiarity with the language.

Graphic maturity is reached when all movement is made from the habituated

neuromuscular patterns, a process that is not totally complete until around 18 years of age. Usually a basic style has been adopted by this age that generally carries through life, although some writers never reach graphic maturity, especially people who do not write frequently.

We recognize graphic maturity through the high skill level exhibited in the handwriting. Fluency in changes of direction is evidence of graphic maturity. Because this writing is executed automatically, it can be written quickly. There is good rhythm in the writing with consistent strokes and a smooth baseline.

Letter forms are uniform, possibly stylized, and may deviate from copybook forms. At this point the writer demonstrates control of the entire process and the writing has become a well developed habit.

This skill level will be maintained until any decline of the writing due to illness, injury or any infirmities of old age cause the writer's control to diminish. Tremor may appear in the writing as one indication of this loss of control.

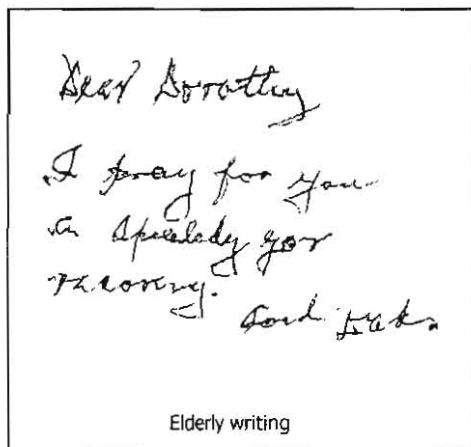
June 1, 1999
Dear Bill and Kathy—
Thought you might
like to see what I
have done with some
of my literature.
Thank you for all
your help and input.
I realize for faking,
white paper would be
better than this beige,
but.....

Kathy, you know
you gave me another
idea when you mentioned

Mature Adult

Writing begins as a difficult skill that must be learned, and through practice and repetition

becomes a habit. Control of the act of writing becomes subconscious. The writer concentrates on the message and not the formation of the letters. Even before writing skill is fully developed, individuality is evident in graphic expression. Under the right conditions, handwriting can be identified at any point along the road to graphic maturity.



Dear Dorothy
I pray for you
in specially for
recovery.
Sincerely, Carol L. L. L.
Elderly writing

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Katherine Koppenhaver, A.A.S., CDE, is a past and current President of NADE, and a long-standing member with Diplomate status. She is the Editor of the NADE Communique and a frequent contributor and workshop presenter. She holds an associate degree in Criminal Justice and has authored numerous books on handwriting identification and other aspects of document examination. Her business, *Forensic Document Examination*, is based in Joppa, Maryland, where she partners with her husband, William Koppenhaver, an expert in evidence photography.

AN INTRODUCTION TO RAMAN SPECTROSCOPY

by
Dr. Mike Claybourn

Introduction

Early in 1928, C V Raman and K S Krishnan published an article in Nature on the modified scattering of light by some organic liquids [1]. It was based on a simple experiment using filtered sunlight focused onto a sample and an observation of the frequency shifted scattered light using a complementary filter. The significance of this was immediately recognized as a new phenomenon of light scattering by molecules and proved the earlier quantum mechanical predictions made by Smekal in 1923, and Kramers and Heisenberg in 1925. The observation was a direct result of a modified scattering of light by the molecular structure and is related to the vibrational modes within a molecule. This scattering effect is unique to a particular molecular structure and therefore became an important tool in chemical identification. Prof. Raman received the Nobel prize for Physics for this work, in 1930.

Since its discovery, the technique has gone through many evolutionary stages - for example, implementation of lasers, combination of spectrometer with a microscope, and Fourier-Transform Raman. In the early 1990s there was a revolution in Raman technological development which led to a significant increase in instrument sensitivity [2]. This was based on a high-efficient single spectrograph in combination

with novel optical elements that gave this increased sensitivity. Renishaw plc led this development and produced the first of a new generation of commercial instruments based around a research grade microscope used for sampling. The outcome of the development has been an avalanche of new fields of application including chemicals, pharmaceuticals, semiconductors, advanced materials, art restoration, archaeological investigation, gemstones and mineralogy, forensics, etc. **The key assets of Raman spectroscopy are chemical selectivity, no sample preparation and it is non-destructive.**

To demonstrate the chemical selectivity of the technique, Figure 1 shows the Raman spectrum for a simple molecule. The spectrum consists of a series of peaks that are shifted (hence Raman shift) in frequency relative to the laser excitation frequency, which is conventionally set as the zero point. Each spectral feature relates to a specific vibrational mode of the molecule - those for the C-H and C=O are shown. Taken as a whole, the spectrum is a fingerprint for the sample material. **For a different molecule, the 'vibrational structure' would be different and hence, so would the Raman spectrum.**

This principle of chemical selectivity has been extended to many applications in the forensic field some of which are now routinely used for obtaining forensic evidence. The applications include paints, fibers, explosives, illicit drugs, firearms discharge residues, fake artefacts, fake gemstones, and inks and documents analysis.

A brief look at the theory

As mentioned above a Raman spectrum can give a unique response to a material and results from an interaction at the molecular level. If a sample is composed of a mixture, then the Raman responses of the components are superimposed.

When laser light impinges on a sample, it undergoes scattering. This effect is dominated by elastically scattered light which has **not** undergone any change and is known as **Rayleigh** scatter.

A very small fraction of the incident laser light (about 1 in 10^7 photons) is scattered at frequencies different from the frequency of the incident photons. The shift in energy of the light is due to inelastic scatter and is termed the Raman effect. The difference in energy between the incident photon and the Raman scattered photon is equal to the energy of a vibration of the scattering molecule. A plot of intensity of scattered light versus energy difference is a Raman spectrum. There are a number of ways of describing the effect - the quantum mechanical picture describes it as an excitation to a virtual state and is shown in Figure 2. 'De-excitation' occurs predominantly to the original state (Rayleigh scatter) with a very small fraction occurring with a change in frequency in the scattered light (Raman scatter). The energy difference between the incident and scattered photons is represented by the arrows of different lengths in Figure 2. The energy difference between the initial and final vibrational levels is known as the Raman shift and has units of wave numbers (cm^{-1}). A more detailed discussion

can be found elsewhere, for example [3].

The spectrum shown in Figure 1 was obtained on a Raman spectrometer similar to that in Figure 3. The laser light enters the spectrometer and is deflected into the optical microscope. The light is focused into a spot on the sample surface where Rayleigh and Raman scatter is produced. The back-scattered light is collected by the microscope objective and re-enters the spectrometer. The special optical assembly known as a holographic filter removes the Rayleigh scattered component and only lets the Raman scatter through to the grating and CCD detector. A full description of the design of Raman spectrometers can be found in [3, 4]

Resonance-Enhanced Raman Scattering.

In addition to the normal Raman response there are certain conditions that give a significant enhancement in the measured signal. If an excitation laser wavelength has sufficient energy to excite the molecule into an electronic state then the intensity of some Raman-active vibrations increases by a factor of 10^2 - 10^4 . This resonance enhancement or resonance Raman effect is a useful tool in specific applications where the enhanced sensitivity is needed. For example, if a component species in a complex matrix shows a resonant enhancement whereas the surrounding material does not, then this species will give a dominating response without spectral interference from the matrix. Resonance Raman is normally performed with UV or visible lasers - the laser of choice will depend upon the energy required for the resonance enhancement. A detailed review of resonance Raman can be found in [3, 4]

Surface-Enhanced Raman Scattering (SERS)

Another Raman approach that gives a significant enhancement over the normal Raman method is Surface Enhanced Raman Scattering or SERS. Conventional SERS has involved attaching molecules to silver surfaces giving a 10^6 increase in Raman sensitivity. The effect is also observable (but weaker) on other metals such as copper and gold. As the laser impinges on the metal surface, there is a massive enhancement of the electromagnetic field at the surface of the metal. Molecules attached to the surface experience this field which leads to the Raman enhancement. Molecular vibrational modes normal to the metal surface give the strongest enhancement. Details of the mechanisms that give rise to the SERS effect can be found in [5]. SERS can provide a practical approach to solving forensic problems - the enhancement in the Raman response can be achieved with silver colloids. These are very easy to produce and use for routine SERS in forensic analysis [6].

Raman methods in document analysis

In any application there is a toolbox of techniques that the forensic scientist may want to use to get a detailed and full forensic analysis. Raman spectroscopy clearly has a role, complementing existing techniques. The effective use of Raman, within the community of forensic document examiners, will have to be defined within the rigors of validated approaches and methods. As with any measurement technology, including those already used, there are pitfalls and dangers.

There are a number of articles describing the use of Raman spectroscopy in inks and documents analysis - see for example [6, 7], and the approach has been discussed at a number of conferences [8-11].

Inks are manufactured to a specific formulation to give appropriate physical and chemical characteristics. When used they are laid down as a thin film onto the appropriate medium usually paper. Raman can be used in a number of ways to determine the chemical fingerprint. Figure 4 shows the Raman spectra for a black ink and paper using a microscope system. The spectra are easily distinguishable from their Raman fingerprints. Raman allows spatially resolved measurements to a limit of about 1 micron.

Figure 5 shows Raman spectra for a series of black ballpoint inks from different manufacturers (a, b, and c) taken at two different Raman excitation wavelengths.

- With 785nm excitation, we are predominantly seeing the normal Raman modes. Figure 5a shows a broad fluorescence with a weak Raman response sitting on top. Figure 5b shows a much weaker fluorescence background and the Raman bands are much better defined. Figure 5c, there are no obvious Raman features - in fact the spectrum appears to be dominated by a broad fluorescence and bands due to amorphous carbon.
- The spectra obtained using 514nm excitation are very different. The spectra were obtained using 1% of the laser power (about 30µW). The reason for the difference is that there is a resonance

enhancement and the molecule has a different vibrational configuration and hence, different spectral features. The reason for such a low laser power is that black ballpoint inks absorb some of the laser energy and can burn - using low power prevents this.

The important point from this data is that in any Raman method development, the measurement configuration must be well defined to get the correct Raman response. For example, using Raman as an ink 'comparator', only data obtained at the same excitation wavelength should be used.

Figure 6 shows Raman spectra for black ballpoint inks that were not distinguishable using standard luminescence techniques available to the QD Examiner. The spectra were obtained using 514nm laser excitation allowing direct comparison. In all cases, the spectrum produces a 'fingerprint' for that particular type of ink - there are clear chemical differences in the ink formulations that allow the spectral discrimination. This data was produced using the method described in [7].

Future development of Raman in QD

There are many issues for Raman spectroscopy in questioned documents, not least is the development of well-defined methods. The user has to have some understanding of limitations and pitfalls to exploit it to its full capabilities. With current level of instrumentation and expertise, Raman can be used effectively for comparative inks work, corroborating and complementing existing techniques. As the application is developed in terms of methodologies, user

experience, capabilities, and databases, Raman will play a significant role. It has three essential ingredients - non-destructive, high spatial resolution and chemical selectivity. In combination, these go beyond the capabilities of alternative techniques. With the prospect of improved instrumentation and application development, Raman is here to stay.

Illustrations for this article follow the references.

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Conference, Cracow, September 2000
Dr Mike Claybourn received his PhD in Applied Physics from the University of Durham, UK in 1985. After 3 years as a Research Fellow running a high-resolution, cryogenic infrared spectroscopy facility, he joined ICI as a senior scientist in

optical spectroscopy providing innovative approaches in research and development projects. In 1996, Mike moved to the LGC, Teddington, UK to manage a national programme in Analytical Innovation concentrating activities in vibrational spectroscopy.

Figure 1 - Raman spectrum for a simple molecule showing the correlation between the functional groups and spectral peaks.

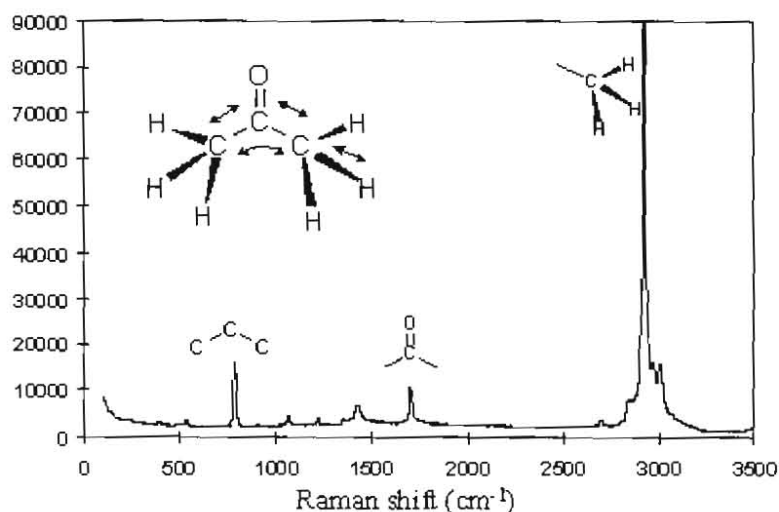
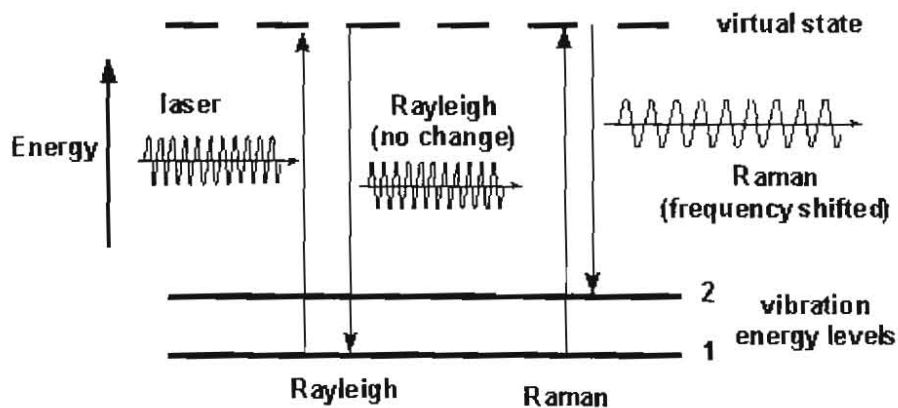


Figure 2 - Schematic View of how the Rayleigh and Raman effects work.



This was followed by a 2 year period within the Raman Division of Renishaw plc, where he developed new applications of Raman spectroscopy including those in forensics. Mike very recently joined AstraZeneca as a senior

scientist in vibrational spectroscopy where he continues to push the boundaries of these technologies. Mike has published extensively in the fields of infrared and Raman spectroscopy.

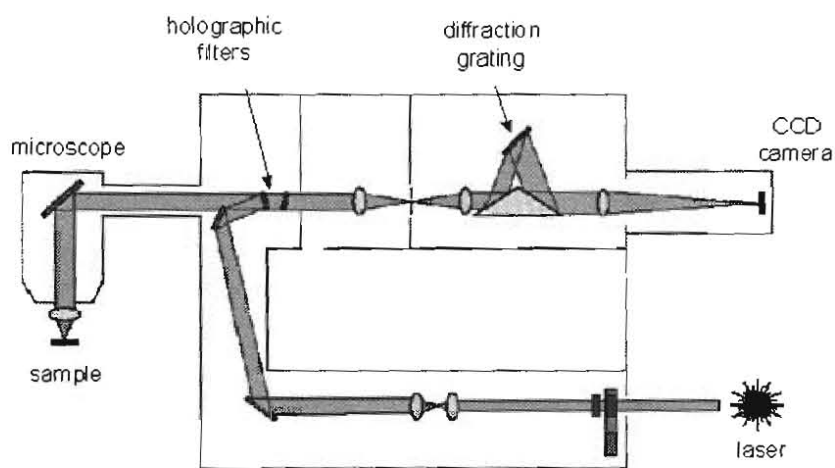


Figure 3 - schematic layout of a Raman spectrometer

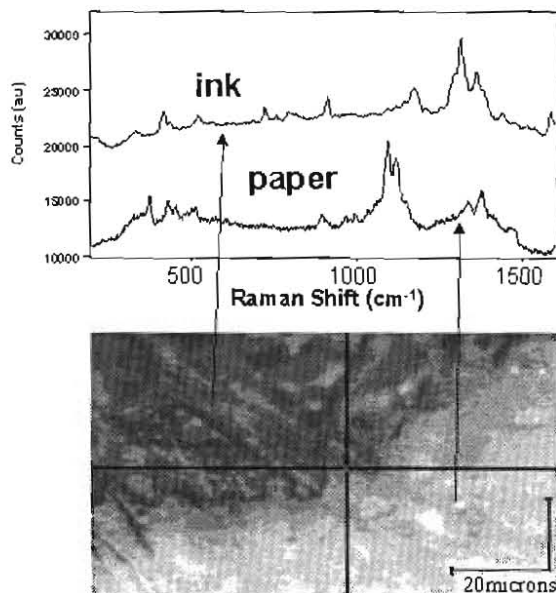


Figure 4 - micro-Raman measurements on ink and paper

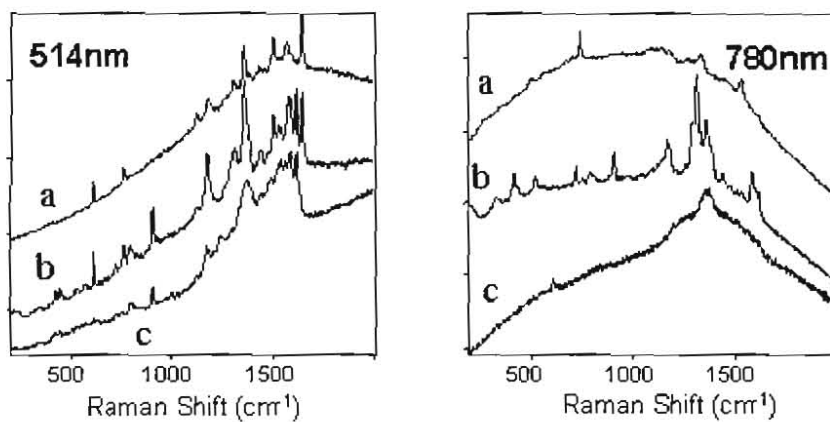


Figure 5 - Raman spectra for inks a, b and c taken with two different laser exciation wavelengths

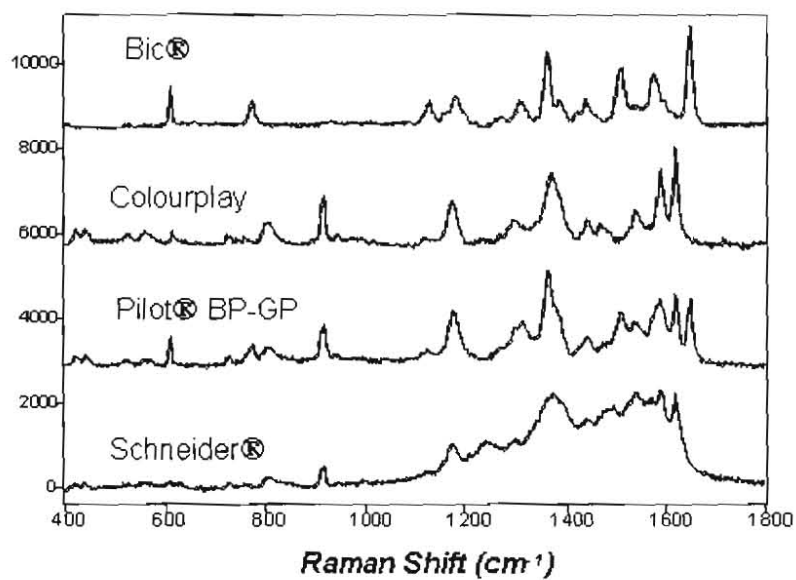


Figure 6 - Raman spectra for 4 black ball-point inks

FORENSICALLY SPEAKING

by

Phyllis Cook, CDE, Diplomate

+ Although many people joke about the illegible "doctor's handwriting" that forensic document examiners recognize as thread, it is no laughing matter. We know that the purpose of writing is to communicate. When one writes so that the message cannot be accurately deciphered, there is a lack of communication, albeit unintentional.

In 1999 a study was undertaken in Atlantic City, NJ by the Institute of Medicine (a part of National Academy of Sciences). The results were astounding and horrifying. Poor handwriting caused misinterpretation of prescriptions that resulted in many deaths.

Hospital officials decided to put a plan into action to stop affecting patients' well being. They arranged a seminar in which handwriting experts taught an italic type of writing, basically bare bones in nature, to hospital personnel. They cut away all curlicues and elaboration, and encouraged more directness in the strokes.

It should be noted that The American Medical Association also admonished physicians about their poor handwriting telling them to either improve their writing skills or start using printscript.

-Reference: *Philadelphia Inquirer*, October 4, 2000 by Jacqueline L. Urgo.

+ In Judaism the Torah (comprising the first five books of the Bible) is handwritten by a sofer or professional scribe. Not only must a

sofer understand the religious magnitude of the individual letters and words, but he must know the prescribed Talmudic laws that govern the entire process from the ritual preparation of the parchment for the scroll from the skin of a kosher animal, to the selection of the ink and quill. It is said that a sofer spends at least a year writing approximately a quarter million letters.

-Reference: Melinda Hofstetter of Fairfax, Virginia in a letter to the editor of *Smithsonian*.

+ Kakemono is a vertical Japanese scroll bearing text.

+ Kanji is a Japanese system of writing using characters derived from the Chinese.

+ Super graffiti is known as "scratchiti." It cannot be painted over or power-washed away. Why? It is etched into glass and plexiglas instead of being spray-painted on walls. Glass can be etched by many ordinary objects (diamond rings, knives, nails, keys). Vandals also use etching chemicals in their scratchiti, and have now hit Northeast Philadelphia, putting scratchiti on bus shelters, store windows, schools, etc.

The worst aspect of scratchiti is its permanence. In order to remove it, windows have to be replaced, often at great expense. Police add that criminal charges could become felonies because of the high cost of damages.

-Reference: *Far Northeast Times Newsweekly*, Wednesday, December 13, 2000, pp. 1, 38.

+ There is a fascinating article of interest to all handwriting experts in the December 2000 issue of *Smithsonian*. It is called, "Inscribing the Word," and was written by Per Ola and Emily D'Aulaire. It tells how, at a scriptorium in Wales, calligraphers are using goose, swan and turkey quills, vellum and gold leaf, color cakes and other pigments, gesso, hematite burnishers, ivory pointers, etc. to create a handwritten Bible applicable to modern times but in the style of medieval art. Such an undertaking has never been attempted since medieval scribes did such work in monasteries.

The painstaking work is being spearheaded by Donald Jackson, the foremost calligrapher in the Western world. Among his credits are his position as scribe to Queen Elizabeth's Crown Office at the House of Lords and leader of calligraphy conferences at St. John's University in Minnesota.

Jackson, using and modifying computer fonts, had to create a new script for this work. Illuminations and marginalia will be included, but they, too, will be modern. Although ancient techniques are used to create this masterpiece, the language will be English.

The photographer for this article was Michael Freeman. His photographs, showing various phases of the calligraphers at work, are art in themselves.

-Reference: *Smithsonian*, December 2000, Volume 31, No. 9, pp 79 - 88.

+ Most of us have toner cartridges for copiers and printers. They should be stored horizontally, out of direct sunlight, at a temperature below 30 degreesC/86 degrees F, and at a humidity of less than 85%.

+ Unused copy paper sheets should be sealed in their original wrapper to protect them from moisture and stored in a cool, dry location. Store copy paper flat, do not stack the packages on end.

+ Hot, humid or cold locations, or areas near water taps, heaters, humidifiers, etc., can adversely affect copiers. So can dusty locations, locations where ammonia gas is generated or poorly ventilated areas. Avoid extreme temperature variations. The rapid heating of a room may cause condensation in a copier with subsequent malfunctions. Keep copiers away from open flames or flammable substances. Do not house your copier near constant vibrations or on uneven surfaces.

+2300 years ago the mathematician Archimedes wrote a 174 page treatise, "On Floating Bodies" Scholars believe that in the 10th century a scribe made a copy of this treatise and that about 200 years later that parchment was erased by a monk who reused it to inscribe a prayer book. A twice used parchment is known as a palimpsest. When this recycling took place in the 12th century, parchment was expensive and the works of Archimedes were not in demand.

Now, in the 21st century, scientists from Johns Hopkins University and the Rochester Institute of Technology are using digital cameras and processing along with UV and IR techniques to reveal the hidden text. Five pages have been completed and the team hopes to complete the project this year.

-Reference: The Associated Press

DIGITAL DEVELOPMENT OF INDENTED WRITING ON QUESTIONED DOCUMENTS

by

J. Wright Leonard, CDE

Abstract: An investigation of digital methodology to develop indented writing is presented, including explanations and comparisons of tested indented writing development procedures performed on an IBM compatible computer. Various types and weights of papers were utilized. The results of test examinations using three photo software programs are reported.

A patient's medical record file obtained from a physician's office was presented for indented writing examination. The file contained numerous handwritten and typewritten medical charts and records, all written on approximately 20 lb. paper, typical of photocopy paper. All records were presented for examination in a standard 9x12 manila folder, in which they had also been maintained for four years. The manila folder was also examined for indented writing.

All medical records and papers contained inside the folder were examined successfully on a Kinderprint Indentation Materializer.² Oblique lighting revealed slight indentations on the manila folder; however, they could not be visually deciphered. The manila folder, as expected, could not be examined with the

Kinderprint due to its thickness.

A successful attempt was made to develop by computer the indented writing on the manila folder, by the following process. Initially, individual sections of the questioned manila folder were scanned into Adobe Photo Deluxe 2.0 Software using the Hewlett Packard Office Pro 1170cse Scanner/Printer/Color Copier. The HP 1170cse provides the HP Pro Picture Scan Software with the equipment which allows sizing of the chosen scanned area of the document before final scanning into the Adobe software, along with color or black/white options. Most scanners have some such tool included. Color scanning was chosen for all items in this project.

Since there was nothing written on the subject folder but suspected indented writing, during the scan a software message reported that it had found nothing to scan. A software message prompted the user to select whether or not to continue scanning. The option to continue was chosen, even though the scanned page at that point appeared blank on the screen.

Once the chosen area of the manila folder was scanned into Adobe Photodeluxe 2.0, the brightness and contrast options were brought forward for adjustment. By gradually adjusting the brightness downward to approximately 2/3 above its lowest capacity, and then adjusting the contrast upward to approximately 3/4 of its highest capacity, the indented writing was brought into view (See Figure 1). When adjusting the brightness and contrast settings, it was necessary to

² The Kinderprint Indentation Materializer is available from Kinderprint at 1-800-6020.

approximate and fluctuate the controls until proper contrast and brightness rendered the particular indented writing visible. The development was then changed/reversed, using the options available, into a negative format, which also proved to be readable and of value (See Figure 1a).

The same indented writing was then developed in Adobe Photoshop 5.0, using the same process. It proved to be superior to the Adobe PhotoDeluxe 2.0 for this task. Photoshop 5.0 produced a clearer development than PhotoDeluxe 2.0, both in color and negative formats (See Figure 2 and 2a). In the same manner, a development (image) of the manila folder was completed using ArcSoft PhotoStudio 2.0 with good results.

In view of this successful image development, tests were completed utilizing various types and weights of paper. A sheet of 20 lb. paper was placed over each test page and words were written thereon with regular pressure utilizing a ballpoint pen with a medium point. All words were written with the same pen and by the same hand while resting on a wooden desk. The results of the tests utilizing three of the most popular photo software programs are listed in Chart One.

Observations:

1. The Adobe 5.0 program produced the best results of the three photo programs tested, giving clearer images and even an indicator when it found something to develop. When indented writing was found the indicator

appeared at the bottom of the screen which read "Watermark Detected."

2. The Adobe PhotoDeluxe 2.0, while much more user-friendly, is not as sophisticated as the Adobe 5.0 or the ArcSoft programs. However less sophisticated, it did produce some positive results, as indicated on the chart and in the illustrations.

3. Once an image is developed it can be converted to a negative image (using Adobe 5.0 or ArcSoft), with the result that sometimes the negative image is clearer, depending on the paper, color, etc.

4. Also, using Adobe 5.0 or ArcSoft, additional adjustments can be made with the Hue/Saturation and/or Tone Adjustment options for a clearer development (image).

5. The ArcSoft Program was the least user-friendly, but in spite of that, it produced images comparable to those of the Adobe 5.0 program.

6. The brightness/contrast adjustments change the colors of the paper.

7. Another program, Kodak PictureEasy 3.1, produced no useful results in terms of this study.

Conclusions:

1. Indented writing can be developed on the computer with the use of a scanner and photo software on numerous types, weights, and colors of paper which are one thickness (page) beneath the page on which the writing was completed. Quality of results may vary due to the paper type or color; the instrument used; the thickness of the paper of the questioned document; the number and thickness of sheet(s) between the questioned document and

the paper on which the subject writing was executed; and the handwriting pressure of the writer(s) who executed the questioned material.

2. Further research is required to determine if developments can be made on papers which are more than one thickness beneath the page on which the writing was completed.

3. The images can then be enlarged or reduced in size, reversed, saved in various formats, inserted in reports, used for exhibits, and/or printed for use in color as they appear on the screen.

4. Indented writing which can not be developed from a standard manila folder using a Kinderprint Indentation Materializer, can sometimes be successfully developed using a computer. In these tests, on some of the other subject papers, the digital method proved equally as productive (and in some cases, even more so) as development on the Kinderprint Indentation Materializer.

5. Clearly, the best digital results were obtained on paper that is thicker, rather than thinner. (Note that 20lb. paper is equivalent to the average photocopy paper, and is considered to be the thinner type.)

6. The final development produced on regular paper with the digital method is more durable than the final development produced on the Kinderprint, and also, being in color, it is a more demonstrative exhibit. The Kinderprint developments are a bit fragile due to the toner-like substance which must be used. Kinderprint developments can, of course, be photocopied; however, the resulting photocopy is sometimes poor.

Illustrations Follow Notes

NOTES:

Hardware Requirements for the referenced photo software programs:

1. Adobe Photoshop 5.0 for Windows (also available for Mac) Intel Pentium or faster Processor

Windows 95 or later

16MB of available RAM (32 Recommended)

40MB of Hard Disk Space

CD Rom

Monitor, 256 Color (8 bit) or greater

Video Card (24 bit color recommended)

2. Adobe PhotoDeluxe 2.0 for Windows (also available for Mac)

Intel 486 Pentium, Pentium Pro or Pentium II Processor.

Windows 95 or later

16 MB RAM (24 Recommended)

Minimum 70MB hard disk space

256 or more color display monitor

3. ArcSoft PhotoStudio 2.0 for Windows (Supplied with the Sony Digital Mavica 88 Camera)

386 PC or faster Processor (486 or better recommended)

Windows 3.1 or 95, or later

4MB of RAM (8 or more recommended)

4 MB of free disk space

VGA display adapter and compatible color monitor (16 or 24 bit Super VGA recommended)

J. Wright Leonard, CDE, with offices in Philadelphia, PA, is a member of the NADE Board of Directors, Chairman of the NADE Budget and Finance Committee, and a Member of the NADE Journal Editorial Staff and the Life Membership Committees.

	ADOBE PHOTO DELUXE 2.0	ADOBE PHOTOSHOP 5.0	ARCISOFT PHOTOSTUDIO 2.0 (Supplied w/ Sony Mavica Camera)
Paper Type			
<u>Std. Manila</u> Folder	Yes	Yes	Yes
<u>38 lb. Paper</u> White	Yes	Yes	Yes
<u>28 lb. Paper</u> Tan Parchment	Partial	Yes	Yes
Grey Parchment	No	No	No
Crane Classic Cream	Partial	Yes	Yes
Royal Fiber Grey	Partial	Partial	No
<u>20 lb. Paper</u> Bright Pink	No	No	No
Orange	No	Partial	Partial
Yellow	No	Partial	Partial
Kelly Green	Yes	Partial	Yes
Bright Blue	Partial	Yes	Yes
White Copy Paper	Partial	Yes	Yes

Chart One - The above chart lists the results of the tests using various software and paper combinations.



Figure 1



Figure 1a



Figure 2



Figure 2a

CASE NOTES

EXAMINATION WITH A VIDEO SPECTRAL COMPARATOR

by
Kay Micklitz, CDE

A request was made by a District Attorney's office to determine whether several entry lines had been added to the original report on a police arrest form and whether more than one ink was present. It was the normal business practice for the police department to use an arrest form set consisting of an original and three self-carbon copies. The document in question was one of these multi-page arrest form sets.

Using the Foster-Freeman Video Spectral Comparator VSC2000, the original questioned document was subjected to infrared testing to determine if the questioned entries were made with different colored inks. This test did not reveal multiple inks, but also does not rule out that possibility.

Several blank arrest form sets were requested in order to perform some experiments during an examination. Experiments were conducted using the blank self-carbon sets to duplicate the information contained in the unquestioned portion of the report and the questioned lines of entry as follows:

(a) 1 original and 3 self-carbon copies for all entries on the report in question;

(b) 1 original and 3 self-carbon copies for the report and after discarding one of the self-carbon copies, only 2 self-carbon copies

for the questioned entries,

(c) 1 original and 3 self-carbon copies on the report and only 1 self-carbon copy for the questioned entries; and

(d) 1 original and 3 self-carbon copies for the report and 0 self-carbon copy for the questioned entries.

One of the capabilities of the VSC2000 is to transmit light beneath the document and to also photograph from the beneath the document. Again, using the VSC2000, the original questioned document was tested with transmitted light. The results of the transmitted light test were photographically captured and printed using the VSC2000. The results of this test indicated a different pressure pattern on the questioned entries than on the other entries on the question document.

A working hypothesis was formed to explain the above observations. If different numbers of backing sheets were present (in the form of self-carbon copies) when the original writing was executed, then perhaps the result would be different pressure patterns.

To test this hypotheses, the reverse side of each experimental test set was examined with the same transmitted light. These results were photographically captured and printed. These photographs showed the following:

1. On test set (a) there was no detectable difference in the pressure patterns
2. On test set (b) there was no detectable difference in the pressure patterns
3. On test set (c) there were varying pressure patterns, and

4. On test set (d) there was a match to the different pressure patterns on the questioned document, on which the questioned entries were of a different pressure pattern from the unquestioned entries.

These results indicated that the additional lines had been added at a later time and without the carbon sets behind the first sheet, which is in agreement with the working hypothesis.

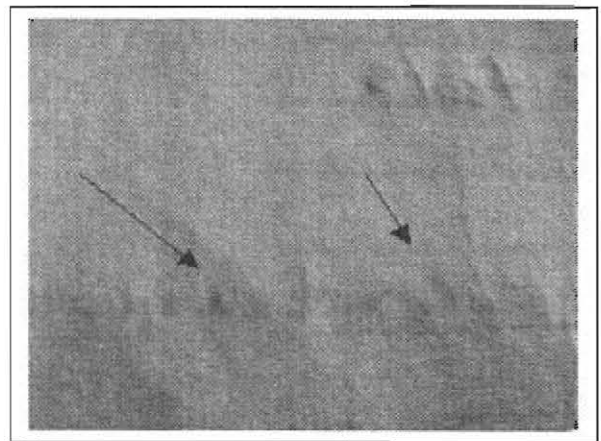
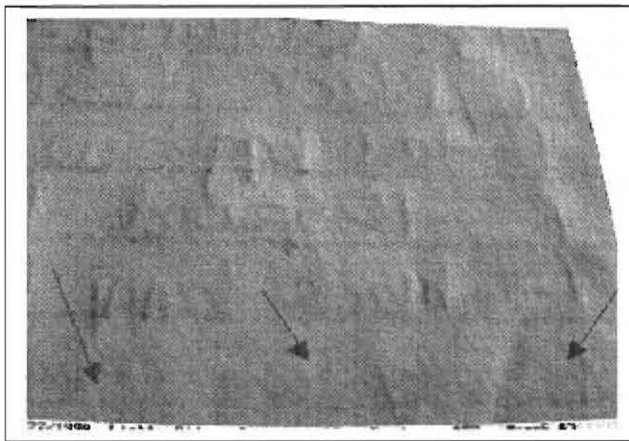
Based on the results of these experiments, it was concluded that the questioned entries on the report submitted for examination were

made under different conditions and/or possibly at a different time from the entries on the original report.

Kay Micklitz, CDE,BCFE, is a board certified document examiner. She holds a paralegal certificate from the University of Texas, San Antonio and has an extensive background in civil litigation. Kay joined NADE in 1994 and earned her CDE in 1997. She completed studies through the National Questioned Document Association and the American Institute of Applied Science for Questioned Documents and Police Photography. Kay is a licensed instructor for the Texas police officers and private investigators. She is court qualified and has been appointed by federal, state and county courts to examine documents.

Items inventoried and Left in Vehicle:		DESCRIPTION AND LOCAT
	C = Console T = Trunk F = Front seat G = Glove box R = Rear seat area	
1 black bag w/ misc clothing	Loc.	1-b
1- Wilson Basketball		1-C
1- Set of Weights		1-p
misc. Clothing - hanging		4-p
1- Black tool box w/ misc tools		2-p
1- tan bag w/ misc clothes		MIS
1- 10 speed bike		MIS
1- black fanny pack with rolling papers & marijuana		2b
1- Sony Walkman cassette player		
RECEIPT: I certify that I		

Questioned entries: "with rolling papers & marijuana; 1-SonyWalkman cassette player"



Examination from the reverse side (transmitted light) using the VSC2000 showing the difference in pressure for the questioned entries.

CASE NOTES

EXAMINATION OF A FAXED DOCUMENT

by
Linda James, BCDE

Typewritten and faxed materials are often the subject of document examinations. In this case the questioned document (fig. 1) is a letter allegedly printed on an Apple Laser Writer II Printer, faxed and copied several times. The issue in this case was not whether the document was faxed first and then copied, or vice-versa, but rather whether the document was genuine or fraudulent. This document had already been the subject of one document examination and the first examiner had concluded that the document was a fraudulent document because in his opinion:

1. the handwritten portion of the document had been faxed, but the typewritten portion had not been faxed, and
2. different fonts were used in the "P.S. line" of the document

Each of these reasons were tested and proven to be incorrect as shown in the following discussions and demonstrations.

1. Determining whether the typewritten document was faxed before being copied.

Faxed material is recognized by the characteristic stair step appearance of slanted lines. Multiple copying tends to obliterate the characteristic stair steps found in faxing due to a reduction in resolution. However, enlarging

documents that have been faxed and copied will still reveal the remains of "stair steps" common

to faxed documents. Close-up photographs of the questioned document have been enlarged. A portion of the enlargement is shown in figure 2a.

In handwriting, longer diagonal lines are used, therefore the stair step is more easily recognized. When a handwriting has been faxed, you can clearly see the characteristic stair steps with the naked eye. This isn't as true with a faxed typed document because most of the lines are short, and either vertical or horizontal. When a faxed typed document has been copied several times, the copier rounds off the steps and eventually covers them.

As an example of how the copier covers the stair steps of a faxed document, envision an uncovered wooden staircase. The wood forms sharp right angles. Now imagine covering the wood with carpet. As you add more layers of carpet, the sharp angle would become more rounded and less noticeable. The same thing happens to a faxed typed document that has been copied many times.

A letter was faxed and mailed to this examiner to be used in a demonstration of this. The faxed copy was copied and re-copied to obtain a sixth generation copy, in order to illustrate the degradation of the stair-step effect. The sixth generation copy was photographed and enlarged using the same procedures as were used on the questioned document. A portion of the enlargement is shown in figure 2b. The mailed hard-copy of the letter was also copied

to the sixth generation and enlarged as shown in figure 2c. Results of this type of procedure will differ depending on the resolution of the copiers used, but as the side-by-side illustration of figures 2a, b and c shows, the faxed demonstration document has the same faxed stair stepped characteristics as the questioned document. This examination determined that the questioned document had indeed been faxed.

Although the faxing of the handwriting was not in question in this case, experiments were done with handwriting, just as with the typewriting. See figures 3a, b and c for illustrated evidence that the handwriting on Q1 was faxed.

Further examination of the line at the top of the questioned document revealed it to be a TTI line. TTI is an abbreviation for *Transmit Terminal Identification*. Many fax machines automatically mark incoming documents with the date, time, and identifier of the transmitting fax unit. This information has to be preset by the operator of the transmitting machine and can be changed anytime.

A line of dots was noted at the upper left portion of the QD (fig 4). This arrangement of dots was enlarged and compared with the enlarged lower edge of the typed TTI line of documents that were faxed from the retaining office of the company involved with Q1 and the cooperating office of the company, which were the two possible sources for a fax (fig. 5a,b). The arrangement of dots on the questioned document did not match the lower edge of the known TTI line of the cooperating office, but did match the corresponding portion of the document from the retaining office. (fig 6). The evidence revealed that at one time the questioned document carried the

TTI line that used the characters and spacing of the TTI line of the retaining office of the company.

2. Determining whether the "P.S. line" was typed with a different front.

The first examiner concluded that the "P.S. line" is in a different font based on the different size of some of the letters. Letters being different in size is not, in and of itself, conclusive of a different font. Fax and copy machines often skew and distort letters. External forces can interfere with fax and copy machines causing distortions and/or misalignment of letters on faxed or copied documents.

External forces such as electronic noise, spatial aliasing, deficient resolutions, paper slippage, poorly focused copiers are only some of the problems that can cause the letters on the document to vary from their original size. Before a conclusion can be reached, letter sizes from different portions of the document must be analyzed to determine the range of variation in letter size within the document. Information from the books *Digital Image Processing* by Gregory A. Baxes and *The Fax Handbook* by Gerald V. Quinn were helpful in this examination.

The following list compares letters from different portions of the questioned document showing a wide variation in character height. Because the human eye is deceived by optical illusion when trying to compare height of letters, a comparator with a linear scale was used to measure the letters. The point counts for the capital letters K", "T", "T", "A", and "D" are listed in the chart below.

"K" Line 3 is 9 pts. .
Line 14 is 8 1/2 pts.
Line 20 is 9 1/2 pts.
Line 29 is 10 3/4

I Line 6 is 8 pts
Line 7 is 10 pts.
1st Line 15 is 8 3/4 pts.
2nd Line 15 is 9 pts.

T Line 5 is 9 1/2
Line 29 is 10 3/4pts.

A Line 3 is 9 pts.
Line 14 is 8 1/2
Line 20 is 9 3/4 pts.
Line 29 is 10 3/4 pts.

D Line 3 is 8 1/2 pts.
Line 19 is 9 pts.
Line 29 is 10 3/4 pts.
Line 6 is 8 1/2 pts.

Figure 7 shows an enlargement of a portion of Q1. The differences in heights of the letters "m" and "r" on two consecutive lines of the document are illustrated.

As shown in the demonstration, many letters in addition to those in the "P.S. line" are of different sizes in the questioned document. A copier or fax machine can change the size, slant, and overall appearance of letters. It is

unlikely that different font sizes were used throughout the document, so the wide range of variation must be a result of outside forces such as faxing and copying.

After a thorough examination of all of the documents presented, the conclusion was reached that the questioned document was a faxed and unknown generation copy of the original, and showed no evidence of having been altered. The new evidence was presented before a grand jury and helped to reverse the original findings.

Linda James is a Board Certified Document Examiner, Certified by the National Association of Document Examiners. As a graduate of the American Institute of Applied Science, she holds a diploma in their Forensic Science Program. She is a licensed instructor for Texas Police Officers and Licensed Private Investigators and currently serves on the Board of the Dallas/Ft Worth Chapter of the Association of Certified Fraud Examiners. Linda has testified in the Texas Probate, Bankruptcy, State, Federal and District Courts, the State Bar of Texas, Wisconsin, Louisiana and Singapore Courts. She has also met and been qualified under the Daubert/Dupont guidelines.

QUESTIONED
DOCUMENT

Heidi:

Re: A&K-Dallas Retainer

Thanks for your offer to sit on the sidelines on this one, even though the search will be centered in Dallas. I think you are probably at a point now where you could handle quite a few of the aspects of a deal like this, but the stakes are so high that I agree it makes more sense for me to handle it myself. You are right in saying that this one is important to me personally as well as professionally--I feel I have a chance to build a solid and broad-based relationship with a client that also happens to be my old law firm, where I have many friends. I expended a lot of personal capital with my old buddies to get this deal, and it is one retainer I intend to earn.

I may take you up on your offer to help with arrangements, scheduling, etc., and I may also let you approach some candidates for me. Also, if you or Kim has the time and would like to attend any meetings, I do think it would be educational for you, although I do not want your work to suffer.

I'm really encouraged about Rush's comments and enthusiasm about growth, and I believe that if I can close one important deal for him in Dallas it will mean significant future business for you and Kim there, as well as for other MWA offices.

jmw

NE

p.s. Thanks for your notes and thoughts about AK-Dallas.

*Jim -
If you want thoughts in
other areas let me know*

HH



Figure 1 - The questioned document, Q1

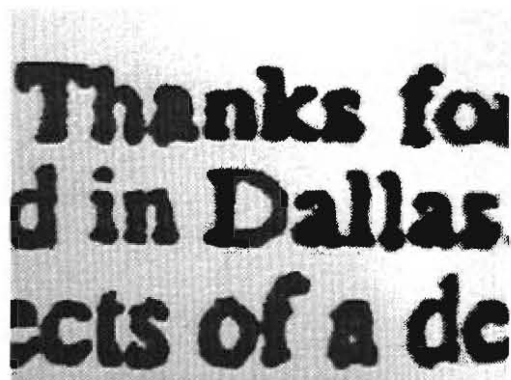


Figure 2a - Enlargement of Q1

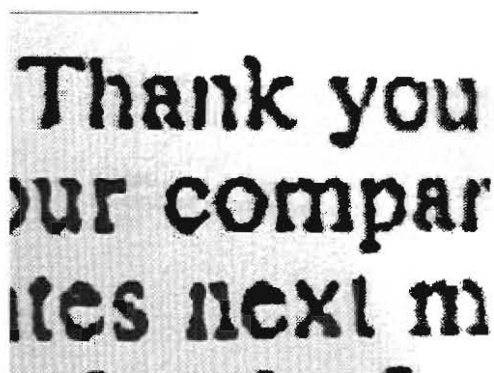


Figure 2b - Enlargement of a known faxed and copied document.

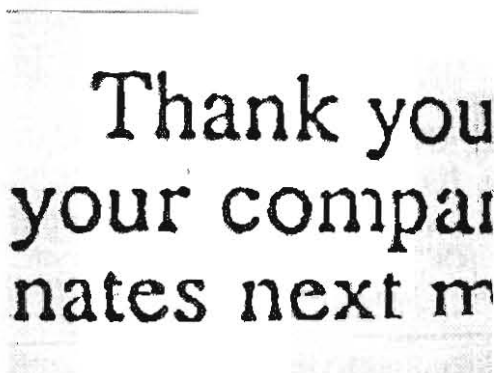


Figure 2c - Enlargement of a known copied, but not faxed, document.

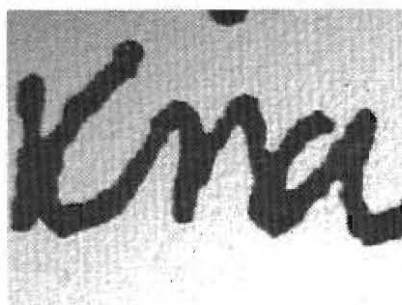


Figure 3a - Enlargement of Q1 handwriting

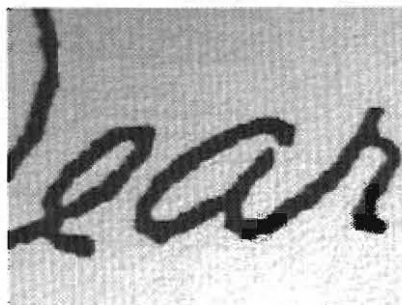


Figure 3b - Enlargement of a known faxed and copied handwriting.

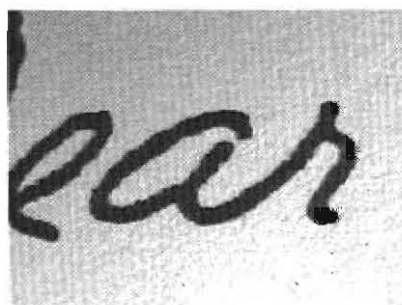


Figure 3c - Enlargement of a known copied, but not faxed, handwriting.



Figure 4 - Enlargement of the TTI line remains on at the top of Q1

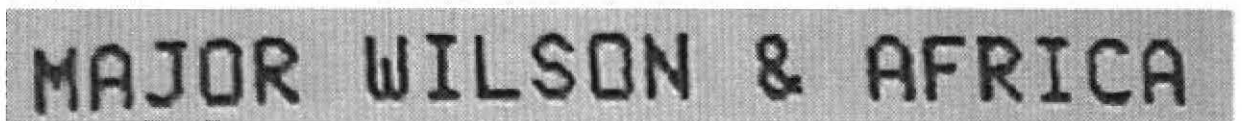


Figure 5a - Enlargement of the TTI line on a document faxed from the **retaining** office.

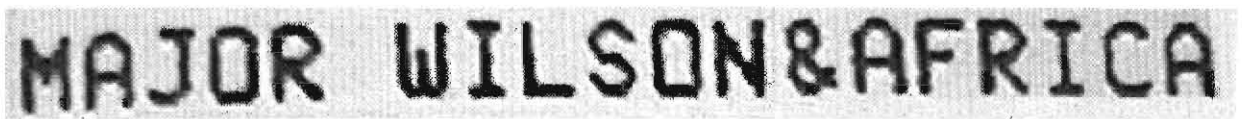


Figure 5b - Enlargement of the TTI line on a document faxed from the **cooperating** office.

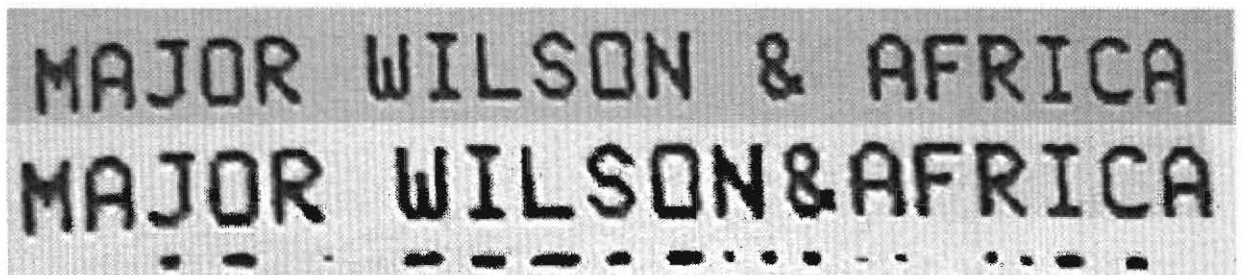


Figure 6 -The TTI line of the **retaining** office (top) fax does not line up with the TTI remains on Q1, but the TTI line of the **cooperating** office fax does.

**ush's comments
for him in Dallas
MWA offices.**

Figure 7 - Different sizes of characters appear throughout Q1. Notice the "m"s in lines 1 and 2.

JOURNAL OF THE NATIONAL ASSOCIATION OF DOCUMENT EXAMINERS

Submission Guidelines

Types of Papers Accepted:

1. Research papers report original, primary research in any area of QDE.
2. State of the Art Reviews survey the published literature on a specific topic in the field of QDE.
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Authors may in general follow any standard style manual. That published by the U.S. Government Printing Office is recommended, since it is regularly up-dated and readily available. Papers should, however, have these features:

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1. Send four (4) printed copies and one (1) 3.5" diskette with either an ascii file, text file, Microsoft Word file, or Word Perfect file of the paper to Emily Will, Editor. Alternatively, submissions may be sent via email to qdewill@mindspring.com

2. As part of the above, submit one camera-ready print copy or electronic file of each exhibit or illustration you intend to have in this paper. If you desire to submit illustrations electronically, contact the editor in advance to discuss format. Each illustration should have a figure number by which it is referred to in the paper, and a caption or text which succinctly identifies it and states its purpose.

3. Deadlines for the next two issues are August 15, 2001 and November 15, 2001.

4. It is highly recommended that you begin the process of writing your paper by discussing the potential for publication with one of the editors via email, telephone or letter. Contact information can be found at the front of the journal. This discussion will take the place of submission of an abstract.

Style and Format:

1. Title of the paper centered at top
2. Name(s) of author, and if multiple, the one(s) who will deal with the Editorial Board should be clearly indicated.
3. A brief professional bio of the author including degrees, certifications and relevant professional information.
4. The paper should have clearly demarcated sections. There are no rigid requirements in this regard, only that it should be logically developed and helpful to the reader.

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